PATENT SPECIFICATION

DRAWINGS ATTACHED

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890,413

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COMPLETE SPECIFICATION

Improvements relating to Electromagnetically Actuated Friction Clutches

We, FERRANTI, LIMITED, a Company registered under the Laws of Great Britain, of Hollinwood in the County of Lancaster, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electromagnetically actuated friction clutches of the type, hereinafter referred to as the type stated, which includes an electromagnet having an armature component associated with a magnet component and adjustably coupled to the frictional members of the clutch in such manner as to urge them into torque-transmitting engagement with one another when the magnet is energised.

For convenience, each of the frictional members will hereinafter be referred to as a clutch plate. Usually one of them is fixed against axial movement whereas the other plate is axially movable to the small extent required for the operation of the clutch. The movable plate is coupled to the armature so that when the magnet is energised the attractive force it exerts on the armature causes the movable plate to be pressed against the axially fixed plate.

The term "clutch," when used hereinafter, should be understood as including the combination of the frictional members and the electromagnetic system which controls them.

In certain servo applications where the clutch plates are in continuous engagement with one another at varying pressures the extent of movement of the armature over the range of pressures is so small that the length of the airgap between it and the magnet poles may be considered constant. Where it is desired that the clutch should possess predetermined current-torque characteristics the length of the airgap is one of the factors that have to be taken into account. This length is however subject to alteration during use owing to the wear of the frictional surfaces. Arrangements are therefore highly desirable whereby at any time during the life of the clutch the airgap length may be easily and rapidly adjustable at will to the designed value so as to allow any end-play that may have developed between armature and clutch plates due to wear of the frictional surfaces to be taken up.

This object could be achieved by the use of a feeler gauge of thickness equal to the required length of the airgap. The gauge could be inserted between armature and pole faces, the magnet energised to tighten the armature against the gauge, and the coupling between armature and clutch plates tightened until the wear is taken up. The use of a feeler gauge is however impracticable where, as is usually an essential requirement, the armature is totally enclosed to prevent its accurate operation being disturbed by dust. This is particularly the case where, to prevent any tendency of the armature to tilt during the gauging process, it is necessary to employ two gauges inserted diametrically opposite one another, or a single gauge of complex shape.

A further disadvantage of using a feeler gauge is that the gauge itself is a separate and probably non-standard component which a some time during the life of the clutch may become lost.

An object of the present invention is accordingly to provide an electromagnetically-actuated friction clutch of the type stated with facilities for adjusting the length of airgap to a constant predetermined value whilst maintaining dust-tight the enclosure in which the armature operates.

Another object is to provide such a clutch including a gauging device to define the predetermined length of the airgap, which device is integral with the clutch.

In accordance with the present invention, there is provided an electromagnetically-

actuated friction clutch of the type having an armature component associated with a magnet component and adjustably coupled to the frictional members of the clutch in such manner as to urge them into torque-transmitting engagement with one another when the magnet is energised, wherein for defining the length of the airgap between the magnet and the armature there is further provided at least one gauging stud or the like secured with respect to one of said components so as to project towards the other component, said other component having a recess to receive freely the free end of the stud when the armature is in its operational position with respect to the magnet, the armature being displaceable in the direction of its operational movement to release the free end of the stud from the recess and then being rotatable about an axis parallel to said direction to an adjustment position in which the free end of the stud may be brought into engagement with a surface of said other component, thereby defining the length of the airgap.

In the drawings accompanying the provisional specification,

Figure 1 is a view in sectional elevation of a clutch in accordance with one embodiment of the invention,

Figure 2 is a section to a reduced scale, and somewhat simplified, on the line II, II of Figure 1,

and Figure 3 shows the view of Figure 2 with the armature displaced for adjustment.

In carrying out the invention in accordance with one form by way of example, an electromagnetically-actuated friction clutch includes an axially fixed frictional member or clutch plate 11 carried by thrust bearings 12 and having peripheral teeth 13 by means of which this plate may be rotated by a gear wheel which is not shown. By means of a frictional surface 14 plate 11 drives an axially movable frictional member or clutch plate 15 having a frictional surface 16 and peripheral teeth 17 to supply an output drive.

Plates 11 and 15 are held in engagement with one another by means of a thrust rod 21 which acts on movable plate 15 by way of a thrust bearing 22. For convenience of description it will be assumed that rod 21 is vertical with bearing 22 at its lower end. The upper end of the rod is threaded to carry an adjusting nut 23 by which the rod is coupled to a coaxial sleeve 24 so that an upward thrust of the sleeve is imparted to the rod and thence is applied to force plate 15 into frictional engagement with plate 11. A locknut 25 is provided to secure nut 23 in the position to which nut 23 is adjusted as described below. This upper end of rod 21 is protected against dust by a clip-on cap 26.

Sleeve 24 extends downwards from nut 23 and at its lower end is secured to the armature 27, which is in the form of a disc coaxial with the sleeve. Surrounding sleeve 24 is an electromagnet of pot form, the winding of which is shown at 28. The sleeve passes through a cylindrical aperture 24^1 in the magnet structure, the sleeve fitting freely enough in this aperture to allow of unimpeded sliding movement but closely enough to be dust tight. Between the pole of the magnet and the armature is an airgap 31. Between the armature and a fixed part 32 of the clutch is a light spring 33. This spring urges the armature upwards—that is, towards the magnet—and hence, by way of sleeve 24 and rod 21, acts so as to maintain the clutch plates in engagement. The spring is just strong enough to do this without causing the plates to engage with sufficient force to transmit an appreciable torque. Sleeve 24 is supported only by spring 33, being free to slide downward over the smooth outer surface 34 of nut 23. To restrict such downward movement of the sleeve it is grooved peripherally near the top to carry a circlip 35 which is normally just clear of the adjacent upper surface 36 of the magnet structure.

With the apparatus so far described, it will be readily appreciated that on energisation of the magnet the armature 27 is attracted upwards, thereby applying a force to raise sleeve 24 and rod 21 upwards and urges the clutch plates into closer engagement. A torque dependent on the value of the energising current is accordingly transmitted by the clutch.

Obviously the length of airgaps 31 is adjustable by means of nut 23, and to allow the clutch to be adjusted to a predetermined length of airgap the following additional equipment is provided.

Near the perimeter of armature 27 are secured two gauging studs 37 (see also Fig. 2) so as to extend towards the pole face 38 of the magnet. In the operational position of the armature these studs are in register with and are freely received by two recesses 39 in pole face 38 so that the free ends of the studs are disengaged, the studs thus having no effect on the axial movement of the armature. Similarly secured to the armature and extending to pole face 38 is a locating dowel 40, which is received by a socket 41 during the operation of the clutch. A second socket for dowel 40 is provided at 42.

In order to ensure that the airgap has the predetermined length, cap 26 and clip 35 are removed, locknut 25 slackened to release nut 23, and nut 23 slackened to provide some end-play. Next, sleeve 24 is depressed downwards, away from nut 23, against spring 33 sufficiently to carry dowel 40 clear of socket 41, thereby carrying studs 37 clear of recesses 39, and the armature is rotated by the sleeve from the operational position of the armature with respect to the magnet until dowel 40 is in register with socket 42, therby defining the adjustment position. This rotation of the

armature, which is clearly about an axis defined by the centre line 21^1 of rod 21, which axis is parallel to the direction of operational movement of the armature, brings studs 37 out of registration with their recesses 39, with the result that when the sleeve is released the spring 33 raises the armature towards the pole face until the studs press against the face, the condition being then as shown in Figure 3. The extent of projection of the studs beyond the armature is such that when their free ends thus engage the pole face the airgap has the predetermined length. The use of two such studs, located diametrically opposite one another, prevents any tendency of the armature to tilt during the gauging process.

The actual adjustment procedure may then be carried out as required. For example, whilst the magnet is energised to retain the armature firmly in position with the studs engaging the pole face and whilst the drive is rotating the driving plate 11, nut 23 is gradually tightened until the end-play is taken up. This is indicated by the first evidence of appreciable torque delivered by the driven plate 15, as shown by some convenient torque-measuring device coupled to that plate. Locknut 25 is tightened to secure nut 23 in the position to which it has been adjusted. Sleeve 24 is depressed to carry dowel 40 clear of socket 24 and the armature is rotated back to its operational position with the dowel in register with socket 41 and the studs 37 in register with their recess 39. The sleeve is then released, and clip 35 and cap 26 replaced. Clip 35 serves to prevent any accidental downward movement of sleeve and armature against spring 33 which might bring dowel 40 clear of socket 41 and cause sufficient rotation of the armature to carry the studs out of register with their recesses, since this would prevent the operation of the clutch until the armature had been restored.

The adjustment may conveniently be effected by means of a single special combination tool comprising a metal tube having a transverse slot at one end for depressing and turning the sleeve 24, a box spanner at the other end for turning nut 23, and a concentric box spanner capable of being inserted in the tube to turn lock-nut 25 whilst the tube iself is holding sleeve 24.

It will be seen from the above description that the armature operates in a dust-tight enclosure 43 and that as sleeve 24 and rod 21 of the coupling between the armature and the frictional members extend outside this enclosure through aperture 24^1, in which sleeve 24 is a dust-tight fit, enclosure 43 remains effectively sealed against dirt and dust even during the adjustment procedure. A clutch in accordance with the invention thus clearly possess the advantage of readily allowing adjustment of the airgap to its predetermined value by enough gauges to prevent tilting of the armature whilst maintaining the airgap in an enclosure so sealed.

A further advantage is that as the gauging device is integral with the clutch there is no chance of the gauge becoming lost during the life of the clutch. It might be thought that this advantage would be offset by the need for a special tool (for adjusting the clutch as described above) which being a separate component might itself be lost. The loss of such a tool would however be unimportant since any competent mechanic could carry out the adjustment procedure with a set of box spanners and a screwdriver, whereas the loss of a suitable feeler, gauge, being a non-standard component, would be almost irreparable.

Various details of the above-described embodiment may be modified in accordance with the invention. For example, the dowel and studs may be secured to the magnet rather than to the armature, with the co-operating recesses in the armature. In a further alternative these features may be located away from the airgap proper, whilst remaining so disposed with respect to the magnet on the one hand and the armature or sleeve on the other hand as still to define the length of the airgap when the armature is displaced from its operational position, in a manner similar to that first described, for the adjustment procedure.

WHAT WE CLAIM IS:—

1. An electromagnetically actuated friction clutch of the type having an armature component associated with a magnet component and adjustably coupled to the frictional members of the clutch in such manner as to urge them into torque-transmitting engagement with one another when the magnet is energised, wherein for defining at will the lenngth of the airgap between the magnet and the armature there is provided at least one gauging stud or the like secured with respect to one of said components so as to project towards the other component, said other component having a recess to receive freely the free end of the stud when the armature is in its operational position with respect to the magnet, the armature being displaceable in the direction of its operational movement to release the free end of the stud from the recess and then being rotatable about an axis parallel to said direction to an adjustment position in which the free end of the stud may be brought into engagement with a surface of said other component, thereby defining the length of the airgap.

2. Apparatus as claimed in claim 1 wherein the said operational and adjustment positions of the armature are defined by means of a dowel or the like secured to one of said components and arranged to engage one or other of two sockets, appropriate to those positions respectively, located in the other component.

3. Apparatus as claimed in either of the two preceding claims wherein the armature

operates in a dust-tight enclosure, the coupling between the armature and the frictional members extending outside the enclosure so as to allow the armature to be displaceable as aforesaid from either of its said positions to the other position whilst maintaining the enclosure dust-tight.

4. An electromagnetically actuated friction clutch substantially as hereinbefore described with reference to the drawings accompanying the provisional specification.

M. E. SIONS,
Agent for the Applicants.

PROVISIONAL SPECIFICATION

Improvements relating to Electromagnetically Actuated Friction Clutches

We, FERRANTI, LIMITED, a Company registered under the Laws of Great Britain, of Hollinwood in the County of Lancaster, do hereby declare this invention to be described in the following statement:—

This invention relates to electromagnetically actuated friction clutches of the type, hereinafter referred to as the type stated, which includes an electromagnet having an armature adjustably coupled to one or both of the frictional components of the clutch in such manner as to urge them in torque-transmitting engagement with one another when the magnet is energised.

For convenience, each of the frictional components will hereinafter be referred to as a clutch plate. Usually one of them is fixed against axial movement whereas the other plate is axially movable to the small extent required for the operation of the clutch. The movable plate is coupled to the armature so that when the magnet is energised the attractive force it exerts on the armature causes the movable plate to be pressed against the axially fixed plate.

The term "clutch," when used hereinafter, should be understood as including the combination of the frictional components and the electromagnetic system which controls them.

In certain servo applications where the clutch plates are in continuous engagement with one another at varying pressures the extent of movement of the armature over the range of pressures is so small that the length of the airgap between it and the magnet poles may be considered constant. Where it is desired that the clutch should possess predetermined current-torque characteristics the length of the airgap is one of the factors that have to be taken into account. This length is however subject to alteration during use owing to the wear of the frictional surfaces. Arrangements are therefore highly desirable whereby at any time during the life of the clutch the airgap length may be easily and rapidly adjustable at will to the designed value so as to allow any end-play that may have developed between armature and clutch plates due to wear of the frictional surfaces to be taken up.

This object could be achieved by the use of a feeler gauge of thickness equal to the required length of the airgap. The gauge could be inserted between armature and pole faces, the magnet energised to tighten the armature against the gauge, and the coupling between armature and clutch plates tightened until the wear is taken up. The use of a feeler gauge is however impracticable where, as is usually an essential requirement, the clutch is totally enclosed to prevent its accurate operation being disturbed by dust. This is particularly the case where, to prevent any tendency of the armature to tilt during the gauging process, it is necessary to employ two gauges inserted diametrically opposite one another, or a single gauge of complex shape.

A further disadvantage of using a feeler gauge is that the gauge itself is a separate and probably non-standard component which at some time during the life of the clutch may become lost.

An object of the present invention is accordingly to provide an electromagnetically-actuated friction clutch of the type stated with facilities for adjusting the length of airgap to a constant predetermined value whilst maintaining dust-tight the enclosure of the clutch.

Another object is to provide such a clutch including a gauging device to define the predetermined length of the airgap, which device is integral with the clutch.

In accordance with the present invention an electromagnetically-actuated friction clutch of the type stated includes for defining the length of the airgap between the magnet and the armature at least one gauging stud or the like secured with respect to the armature or the magnet structure so as to project towards the magnet structure or armature, as the case may be, means being provided for rotating the armature, about an axis parallel to the direction of its operational movement, from its operational position with respect to the magnet, in which position the free end of the stud is located in a recess, to an adjustment position in which the free end of the stud engages a surface of the magnet structure or armature, as the case may be, whereby the length of the airgap is defined.

The operational and adjustment positions of the armature may be defined by means of a dowel or the like secured to the armature or the magnet structure and adapted to engage one or other of two sockets, appropriate to

those positions respectively, located in the magnet structure or armature as the case may be.

In the accompanying drawings

Figure 1 is a view in sectional elevation of a clutch in accordance with one embodiment of the invention,

Figure 2 is a section to a reduced scale, and somewhat simplified, on the line II, II of Figure 1,

and Figure 3 shows the view of Figure 2 with the armature displaced for adjustment.

In carrying out the invention in accordance with one form by way of example, an electromagnetically actuated friction clutch includes an axially fixed frictional component or clutch plate 11 carried by thrust bearings 12 and having peripheral teeth 13 by means of which this plate may be rotated by a gear wheel which is not shown. By means of a frictional surface 14 plate 11 drives an axially movable frictional component or clutch plate 15 having a frictional surface 16 and peripheral teeth 17 to supply an output drive.

Plates 11 and 15 are held in engagement with one another by means of a thrust rod 21 which acts on movable plate 15 by way of a thrust bearing 22. For convenience of description it will be assumed that rod 21 is vertical with bearing 22 at its lower end. The upper end of the rod is threaded to carry an adjusting nut 23 by which the rod is coupled to a coaxial sleeve 24 so that an upward thrust of the sleeve is imparted to the rod and thence is applied to force plate 15 into frictional engagement with plate 11. A locknut 25 is provided to secure nut 23 in the position to which nut 23 is adjusted as described below. This upper end of rod 21 is protected against dust by a clip-on cap 26.

Sleeve 24 extends downwards from nut 23 and at its lower end is secured to the armature 27, which is in the form of a disc coaxial with the sleeve. Surrounding the sleeve is an electromagnet of pot form, the winding of which is shown aa 28. Between the pole of the magnet and the armature is an airgap 31. Between the armature and a fixed part 32 of the clutch is a light spring 33. This spring urges the armature upwards—that is, towards the magnet—and hence, by way of sleeve 24 and rod 21, acts so as to maintain the clutch plates in engagement. The spring is just strong enough to do this without causing the plates to engage with sufficient force to transmit an appreciable torque. Sleeve 24 is supported only by spring 33, being free to slide downward over the smooth outer surface 34 of nut 23. To restrict such downward movement of the sleeve it is grooved peripherally near the top to carry a circlip 35 which is normally just clear of the adjacent upper surface 36 of the magnet structure.

With the apparatus so far described, it will be readily appreciated that on energisation of the magnet the armature 27 is attracted upwards, thereby applying a force to raise sleeve 24 and rod 21 upwards and urge the clutch plates into closer engagement. A torque dependent on the value of the energising current is accordingly transmitted by the clutch.

Obviously the length of airgap 31 is adjustable by means of nut 23, and to allow the clutch to be adjusted to a predetermined length of airgap the following additional equipment is provided.

Near the perimeter of armature 27 are secured two gauging studs 37 (see also Fig. 2) so as to extend towards the pole face 38 of the magnet. In the operational position of the armature these studs are in register with and are received by two sockets 39 in pole face 38 so that the free ends of the studs are disengaged, the studs thus having no effect on the axial movement of the armature. Similarly secured to the armature and extending to pole face 38 is a locating dowel 40, which is also received by a socket 41 during the operation of the clutch. A second socket for dowel 40 is provided at 42.

In order to ensure that the airgap has the predetermined length cap 26 and clip 35 are removed, locknut 25 slackened to release nut 23, and nut 23 slackened to provide some endlay. Next, sleeve 24 is depressed downwards, away from nut 23, against spring 33 sufficiently to carry dowel 40 clear of socket 41 and the armature is rotated by the sleeve from the operational position of the armature with respect to the magnet until dowel 40 is in register with socket 42. This rotation of the armature, which is clearly about an axis defined by the centre line 21^1 of rod 21, which axis is parallel to the direction of operational movement of the armature, brings studs 37 out of registration with their sockets 39, with the result that when the sleeve is released the spring 33 raises the armature towards the pole face until the studs press against the face, the condition being then as shown in Fig. 3. The extent of projection of the studs beyond the armature is such that when their free ends thus engage the pole face the airgap has the predetermined length. The use of two such studs, located diametrically opposite one another, prevents any tendency of the armature to tilt during the gauging process.

The actual adjustment procedure may then be carried out as required. For example, whilst the magnet is energised to retain the armature firmly in position with the studs engaging the pole face and whilst the drive is rotating the driving plate 11, nut 23 is gradually tightened until the end-play is taken up. This is indicated by the first evidence of appreciable torque delivered by the driven plate 15, as shown by some convenient torque-measuring device coupled to that plate. Locknut 25 is tightened to secure nut 23 in the position to which it has been adjusted. Sleeve

24 is depressed to carry dowel 40 clear of socket 24 and the armature is rotated back to its operational position with the dowel in register with socket 41 and the studs 37 in register with their sockets 39. The sleeve is then released, and clip 35 and cap 26 replaced. Clip 35 serves to prevent any fortuitous downward movement of sleeve and armature against spring 33 which might bring dowel 40 clear of socket 41 and cause sufficient rotation of the armature to carry the studs out of register with their sockets, since this would prevent the operation of the clutch until the armature had been restored.

The adjustment may conveniently be effected by means of a single special combination tool comprising a metal tube having a transverse slot at one end for depressing and turning the sleeve 24, a box spanner at the other end for turning nut 23, and a concentric box spanner capable of being inserted in the tube to turn lock-nut 25 whilst the tube itself is holding sleeve 24.

It will be seen from the above description that the armature operates in an enclosure 43 which even during the adjustment procedure is effectively sealed against dirt and dust. A clutch in accordance with the invention thus clearly possess the advantage of readily allowing adjustment of the airgap to its predetermined value by enough gauges to prevent tilting of the armature whilst maintaining the airgap in an enclosure so sealed.

A further advantage is that as the gauging device is integral with the clutch there is no chance of the gauge becoming lost during the life of the clutch. It might be thought that this advantage would be offset by the need for a special tool (for adjusting the clutch as described above) which being a separate component might itself be lost. The loss of such a tool would however be unimportant since any competent mechanic could carry out the adjustment procedure with a set of box spanners and a screwdriver, whereas the loss of a suitable feeler gauge, being a non-standard component, would be almost irreparable.

Various details of the above-described embodiment may be modified in accordance with the invention. For example, the dowel and studs may be secured to the magnet structure rather than to the armature, with the cooperating sockets or other form of recesses in the armature. In a further alternative these features may be located away from the airgap proper, whilst remaining so disposed with respect to the magnet structure on the one hand and the armature or sleeve on the other hand as still to define the length of the airgap when the armature is displaced from its operational position, in a manner similar to that first described, for the adjustment procedure.

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890413 PROVISIONAL SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 1.

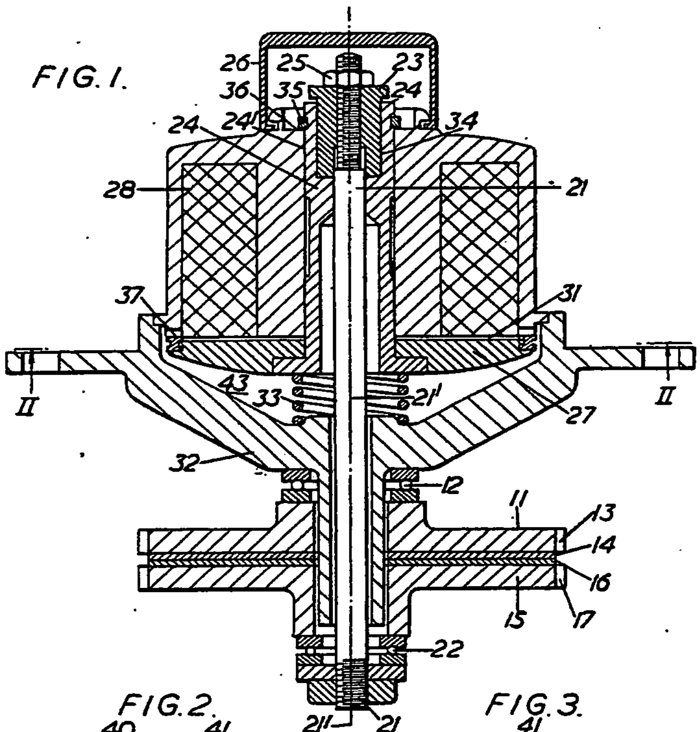

FIG. 2.

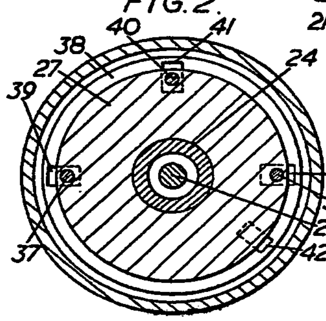

FIG. 3.